Observation of hydrogen and nitrogen pellets at the ANKE pellet target*

W.Borgs, M.Büscher, A.Bukharov[a], V.Chernetsky[b], V.Chernyshev[b], P.Fedorets[b], A.Semenov[a]

During 2004 several pellet-target test runs have been performed according to the final stage of ISTC[1] project #1966. The target — comprising a cryostat with the pellet generator and the dumping system — is currently installed in the COSY accelerator hall (Fig. 1) in a support construction which can later be moved to an internal target place of COSY.

Fig. 1: The pellet-target test-setup in the COSY hall.

In a pellet target a continuous flow of droplets is generated by injecting a liquefied gas through a thin vibrating nozzle into a triple-point chamber (TPC), where temperatures and pressures close to TP conditions for the particular target material are maintained. These droplets freeze and form the pellets when they pass through a sluice (length ∼5 cm, inner diameter ∼0.6 mm) into vacuum. The tests in 2004 focused on the optimization of nozzle and sluice components.

In order to develop technologies for bulk production of nozzles, two different nozzle types have been tested. About 20 capillary glass nozzles — glued into brass or steel housings — with outlet diameters ranging from $ø = 8$ to $45\,\mu$m have been produced. 10 of these were tested for liquid jet generation as well as stainless steel nozzles with $ø = 25$ and $38\,\mu$m. All nozzles provided stable generation of liquid hydrogen and nitrogen jets, while the jet velocities are roughly two times larger for the glass nozzles. The process of jet and droplet formation can be observed with a fast CCD camera which is installed close to a window in the TPC, see Fig. 2.

Due to the cooling and warming time of the target cryostat, about 3 days are needed for testing each nozzle. Thus a dedicated test cryostat has been assembled at ITEP in order to minimize the time for nozzle tests during target operation at the FZJ. New nozzles produced in Russia will be tested and selected before being transfered to the Germany.

For observation of frozen corpuscles a second CCD camera has been installed close to quartz glass window of the first vacuum chamber and focused on the outlet of sluice from the TPC. To observe 30 μm pellets the optical magnification must not be less than a factor 50. Due to the sensitive time of the CCD ($\sim 5\,\mu$s) the pellets are currrently observed as short

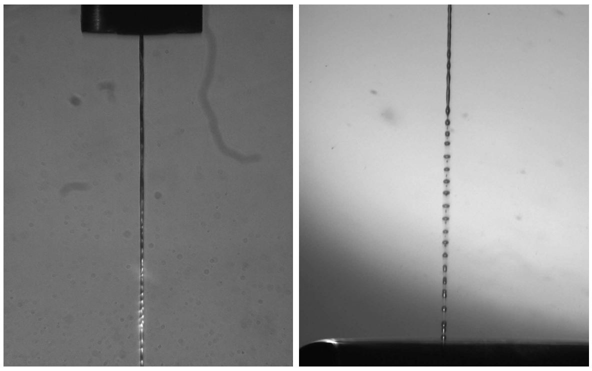

Fig. 2: Injection of an H_2 jet through a steel nozzle with $ø = 38\,\mu$m into the TPC (left). Breakup of a jet into droplets before the sluice to the first vacuum chamber (right).

tracks with lengths depending on their velocities (Fig. 3). The frequency of pellet detection is 300 Hz, at 3 kHz for the droplet generation. The measured pellet velocity is about 30–50 m/s which is close to the expected value. The information from the CCDs is written to disk for subsequent analyses.

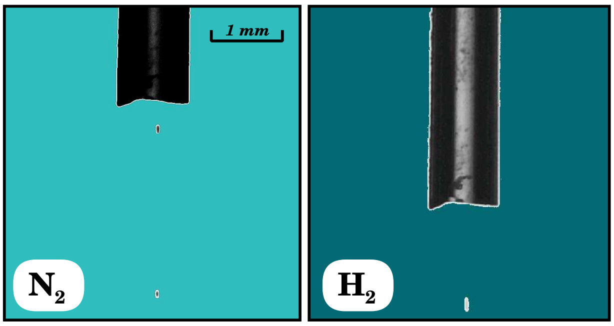

Fig. 3: N_2 and H_2 frozen pellets with $ø\sim 30\,\mu$m ($ø_{\mathrm{nozzle}} = 18\,\mu$m) behind the sluice to the vacuum chamber.

During the November/December test runs long-term stability of liquid jet generation has been achieved. In the vacuum chamber stable generation of hydrogen and nitrogen pellets with different diameters has been obtained and observed, see Table 1. The tests were carried out during 10 days of permanent target operation. Since hydrogen and nitrogen pellets have been generated for many hours the target demonstrated its reliability for installation at the internal beam of COSY.

Table 1: Main results of the nozzle tests.

Nozzle type	Nozzle ø	Target material	Pellet ø
Steel	$25\,\mu$m	H_2	$50\,\mu$m
	$38\,\mu$m	H_2	$70\,\mu$m
	$38\,\mu$m	N_2	$70\,\mu$m
Glass	$10\,\mu$m	H_2	$< 20\,\mu$m
	$18\,\mu$m	H_2	$30\,\mu$m
	$18\,\mu$m	N_2	$30\,\mu$m
	$40\,\mu$m	H_2	$70\,\mu$m

[1] International Science and Technology Center, Moscow, http://www.istc.ru

[a]MPEI, Moscow, [b]ITEP, Moscow

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